THIS ITEM DOES NOT
CIRCULATE

THE NATIONAL INSTITUTE OF DENTAL RESEARCH

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE • Public Health Service

PHS
NO.1340
1966

THE NATIONAL INSTITUTE OF

DENTAL RESEARCH

NATIONAL INSTITUTES OF HEALTH • Bethesda, Maryland

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C., 20402 - Price 45 cents

When
the
Dental
Institute
Began
in 1948 . . .

Dental research was the responsibility of a handful of men and women faced with a gigantic problem. Their mission, set forth by act of Congress and signed into law by President Truman on June 24, 1948, was to find the causes and to establish means of prevention and treatment for the oral diseases that afflict mankind. They had, in addition, the difficult task of interpreting to the world the significance of the oral diseases they fought.

Their forebear in this effort was Dr. H. Trendley Dean, assigned in 1931 to the Dental Hygiene Unit in the newly formed National Institute of Health. Serving as the only dental officer in this unit for some years, Doctor Dean pioneered in the epidemiologic study of dental mottling, now known as dental fluorosis. His work yielded precise data on the effects of various fluoride concentrations in water, leading to the establishment of safe levels which would assure protection against dental caries without risk of mottled teeth.

The work of the Dental Hygiene Unit and the efforts of the American Dental Association to expand dental research in the United States led to the enactment by Congress of legislation formally establishing the National Institute of Dental Research. Doctor Dean was named its first director.

Today, almost 300 people are employed at the Institute. Their responsibilities cover direct research activities, support for research programs in universities and institutions throughout the world, and training programs for research manpower to expand the dental research resources of the future.

The breadth and interdisciplinary character of modern dental research are reflected in the names of the Institute's laboratories: Epidemiology, Microbiology, Histology and Pathology, Biochemistry, Human Genetics, Oral Medicine and Surgery, and Dental Services.

As this research base has broadened beyond the traditional dental sciences, requirements for trained manpower have grown apace. In the Institute itself, as well as in universities throughout the country, there is need for basic scientists to lend their specialized knowledge and skills to the solution of problems of oral disease.

It is hoped that this brief review of oral diseases and research efforts will create an awareness of the expanding world of dental research; that it may present a new career vista to the young student, bring a new perception and opportunity to the basic scientist and the research-oriented dentist, and contribute to a better understanding by the practicing dentist of the research efforts of today that may find clinical application tomorrow.

Francis A. Arnold, Jr., D.D.S., *Director*,
National Institute of Dental Research.

25ml

RESEARCH

holds our hope for the answers . . .

DENTAL CARIES is the most prevalent disease in the United States

Teeth in the skull of a small pig are checked to determine effect of diet changes. Pigs, like man, have deciduous (baby) teeth and permanent teeth right underneath them.

Indeed, dental decay is probably the most prevalent disease affecting all mankind. It is certainly one of the oldest. Ancient documents refer to it, and decayed teeth in skulls of prehistoric man attest to it.

In the United States, 98 percent of the population fall victim to dental caries. In the world, the figure is 90 percent or more. This wide prevalence has resulted, in large part, from the introduction of refined starches, particularly wheat and sugar, as the mainstay of diet.

RESEARCH AND THE ANSWERS

Research has shown that interactions between diet, certain kinds of bacteria, and tooth susceptibility produce decay. If the diet is not high in refined carbohydrates, decay is low or absent. Similarly, if there are no decay-producing bacteria, or, if the tooth surface is not susceptible, there is no decay. *All* three factors must be present for the onset of caries.

Efforts to strengthen tooth resistance to decay center on the use of fluorides. Ingestion of small quantities of fluoride while the teeth are erupting will contribute to their protection against decay. This protection also carries over into adult life. Epidemiologic studies extending over three decades have shown that an optimum amount of fluoride (1 part per million parts of drinking water) cuts down tooth decay by one-half to two-thirds. Excessive fluoride, on the other hand, can cause mottling of teeth.

Today's fluoride researchers investigate ways of providing the mineral where fluoridation of water is impractical. Salt, foods, tablets, and topical application directly to the teeth are being studied.

Definitive knowledge as to *why* fluoride inhibits caries is emerging from biophysical studies of the whole process of calcification. Through X-ray diffraction and electron microscopy, much information has been developed on the ultrastructure of teeth, the

crystals comprising the enamel, the dimensions of these crystals, and their orientation within the prismatic units. These findings by scientists at the Dental Institute and by grantee investigators have contributed greatly to the understanding of the morphology of ultramicroscopic structure of hard dental tissues.

In bones, high fluoride content tends to make the crystals more perfect and more stable. Fluoride also replaces the hydroxyl ions in the calcium phosphate of bone, making the bone itself less soluble. Since bones and teeth share common properties, this may be the reason that fluoride-protected teeth are more resistant to decay. The study of crystal development in young enamel may shed some light on how dental decay is caused, as well as on the factors which make decay more commonly a disease of youth.

The microbiologists have reasoned that tooth decay is a bacterial infection, developing when the mineral components of enamel dissolve in acids released under bacterial accumulations which have colonized on the tooth surfaces. In exploring what bacteria contribute most importantly to caries activity, they have found some significant leads in germ-free animal research. Specific strains of streptococci which produce decay in the hamster and in the rat have been identified. A streptococcus which will induce caries in the hamster has also been isolated from human carious teeth.

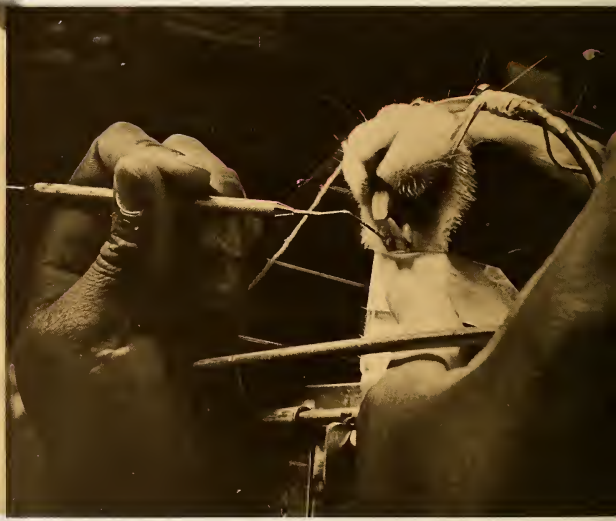
In nutrition studies, biochemists seek information as to how contact of various types of food with the teeth influences decay. Preliminary evidence suggests that phosphates hold promise for effectively reducing caries by changing the bacterial action on carbohydrates in the diet.

Much still remains for study: Is caries transmissible in man, as it is in certain animals? What is the specific response of the carious lesion to the bacteria which invade the highly calcified enamel and dentin? What is the relationship between the chemical components of enamel apatite and bacterial metabolism? What is the anti-caries potential of antibiotics and other preparations? Scientists in dental research laboratories throughout the country are looking for answers to these and many other questions.

One method of applying fluoride to teeth of hamsters is the thermoplastic, vinyl mouth applicator shown above, held by forceps. The miniature mouthguard, applied for a few minutes a day, will retard tooth decay and prevent development of new cavities.

Dental examinations are conducted in oversea populations to collect data on the relation of nutrition to oral diseases.

PERIODONTAL DISEASE



The effects on rabbit gum tissue of various substances are studied for their relationship to the cause of periodontal disease.

is the major cause of loss of teeth in adults . . .

Throughout the world people of all times have associated toothlessness with old age. They have accepted with reluctant resignation the inevitable loss of teeth beginning in midlife, a loss attributable to the insidious slow weakening of the tissues and membranes around the teeth and the gradual deterioration of the supporting bone.

Recent research in methods of treating and controlling periodontal disease has wrought a happy change in attitude. Tooth loss is no longer considered inevitable.

RESEARCH SEEKS ANSWERS

Scientists of the Dental Institute have searched worldwide for the clinical variables to assess periodontal disease. To permit accurate statistical analysis, they developed a Periodontal Index—a method of scoring clinical observations on the state of the gums and other periodontal tissues. Against this standard could be assessed all the many varying factors of geography, population, stress, age, sex, diet, nutrition, economic status, and other conditions. This method is now in use by epidemiologists in some 30 different countries.

These studies have clearly shown that nutrition, altitude, climate, and other factors are completely irrelevant. People all over the world have the disease regardless of their nutritional and economic state. However, it is also clearly evident that the amount and severity of periodontal disease increase markedly with the advancing age of the population. The disease is also more prevalent when oral hygiene is not practiced.

Current research is exploring the effects of fluoridation on periodontal disease. There is some indication that life-long residence in an area of fluoridated water confers some protection against periodontal disease, and that fluoride reduces accumulations of plaque and calculus on tooth surfaces.

Microbiologists at the Dental Institute have shown that in laboratory animals a condition similar to periodontal disease is caused by a filamentous microorganism. Inoculation with the organism produces periodontal disease in the hamster, and the condition can be transmitted from an infected animal to an uninfected animal.

Researchers have also probed into the mechanisms of calculus formation. It has been found that calculus consists essentially of mineralized bacterial deposits and that virtually all the oral microorganisms are subject to such mineralization, particularly when they die. However, calculus does not form when the major

salivary glands are removed.

Histochemical studies of enzyme systems in normal and diseased periodontal tissues offer other promising leads. They have revealed the presence of a connective tissue fiber (the oxytalan fiber) previously unrecognized and are providing greater insight into the nature of the molecular changes in normal and inflamed tissue.

A major area of study involves the processes of maturation of collagen, the most important component of connective tissue. In

Embryonic chick aortas are used in studies of the role of ascorbic acid in the formation of collagen, an important constituent of the hard and soft tissues of the oral cavity.

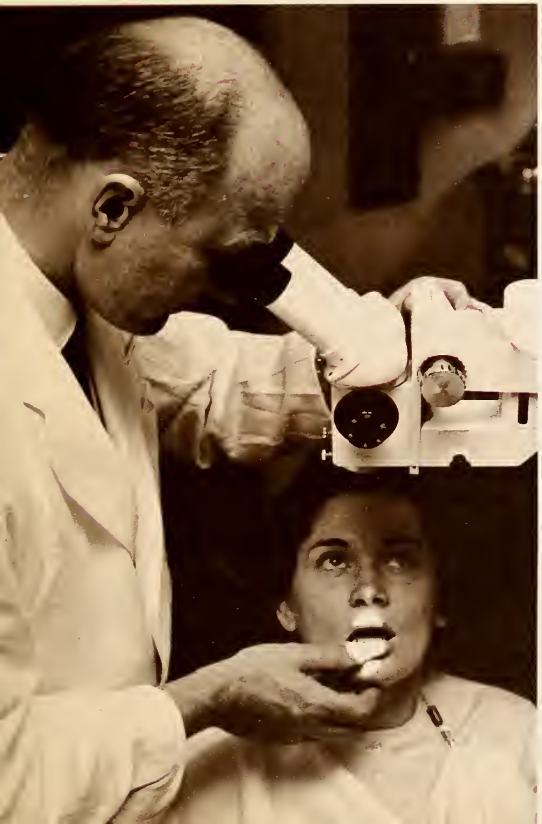
research on the biochemical and physiochemical bonds which hold the constituents of collagen together, Dental Institute scientists have shown that defects in the intramolecular and intermolecular crosslinking patterns may strongly influence the tissue breakdown which occurs in periodontal disease.

While basic research focuses on the cause of periodontal disease, clinical efforts are directed toward therapy and prevention. New methods of approach to the problems of adolescent periodontosis and technics of antibiotic therapy are under development. Many of the extramural research projects supported by the Dental Institute contribute to this effort to better understand and control the disease.

The attacks on periodontal disease are truly many pronged, all directed at the eradication of the toothlessness of old age.

THE MOUTH CAN HAVE MANY DISEASES

—as minor as a local irritation, as serious as cancer . . .



Oral ulcerations, known by some 50 common names, are bothersome ailments. They not only are painful, but they also tend often to recur in numerous episodes. Prevention and therapy are difficult.

Single ulcers or multiple ulcerations afflict at one time or another probably half of the world's population. Here, as in so many disease conditions, the problem is one of slight but ubiquitous disease. The amount of pain and distress depends upon the severity, type, and frequency of the ulcerations.

Problems have a wide range:

Primary herpes, a highly contagious disease which chiefly affects children, and can involve the entire mouth in a condition called herpetic stomatitis.

Recurrent labial herpes, the recurrent form of primary herpes, commonly called fever blisters or cold sores, and occurring only on the lips.

Oral ulcerations, such as fever blisters and canker sores, affect a high percentage of the population. Here, a Dental Institute scientist looks through a direct view microscope to check changes in a patient's lesion before they can be seen with the eye alone. The microscope magnifies up to 40 times.

Researcher prepares the Herpes Simplex virus for inoculation onto rabbit kidney cell cultures in studies of the antigenic properties of this virus, causative agent of the recurrent form of primary herpes.

Aphthous ulcers (canker sores), lesions of the lips, intraoral mucosa, tongue, soft palate, floor of the mouth, and gingivae. They are very painful and may be recurrent.

Periadenitis aphthae, exaggerated form of recurrent canker sores.

Erythema multiforme is a serious disease in contrast to the common variety of oral ulcerations. It is characterized by various sized blisters which develop on the oral mucosa, tongue, and lips. Still rarer is the form of the disease in which blisters or bullae appear intraorally and on the skin.

Pemphigus, most severe and rarest type of oral ulceration, is another recurrent disease involving both the mouth and skin. Its cause is not understood. In the acute form, pemphigus is a serious disease, with only about a 50 percent recovery rate.

Leukoplakia—marked by white, thickened patches on the mucous membranes of the cheeks, gums, or tongue—must be evaluated carefully because of its possible relation to cancer. Epidermoid cancer sometimes develops from the leukoplakia.

Oral cancer constitutes 4 or 5 percent of all types of cancer. If detected early, it can be treated successfully.

PROGRESS IN RESEARCH

Utilizing an interdisciplinary approach, the Dental Institute conducts and supports a variety of studies on oral mucosal disorders.

The mitotic rate of normal and abnormal oral epithelium is under study.

Histochemical and histopathological diagnostic criteria for oral lesions are under development.

The role of microorganisms in causing oral ulcerations is being evaluated.

Histopathologists have contributed basic information in their

investigations of cellular forms and metabolism in leukoplakic and neoplastic areas, as well as ulcerative lesions. The identification of bacterial and viral forms has been facilitated by the electron microscope. Some investigators have used immunological methods to gain a better understanding of the pathogenic potential of a variety of oral microorganisms. Other research focuses on the morphological and biochemical characteristics of microorganisms known to be harmful—or potentially harmful—to oral mucosa. Biochemists are investigating effects of products of bacterial and viral metabolism upon oral tissues.

Further factors which have been brought to bear in research on canker sores include hypersensitivity, heredity, endocrinology, nutrition, and trauma, as well as psychologic influences.

The most promising lead thus far has been the isolation of an unusual l-form of bacteria from the ulcers and bloodstream of canker sore patients. This finding—made in collaboration with the Division of Biologics Standards—suggests that a phase of this microorganism can remain dormant and may be responsible for the recurrence of lesions at the same site.

While aphthous ulcers seem apparently to have a bacterial cause, herpes is due to a viral factor. Scientists at the Dental Institute are able to produce intraoral herpetic lesions in rabbits by inoculating the cheek mucosa with the herpes simplex virus. These lesions are then subjected to clinical, cultural, and histologic study.

Until recently, treatment of these painful and sometimes serious afflictions was largely related to the relief of pain. Today, investigators, directing their attention to prevention and cure, are testing corticosteroids and antibiotics, and are making efforts to develop a preventive vaccine.

In the serious deforming lesions of cancer, the skills of the oral surgeon and the dental prostheses expert have provided important clinical assistance. Research in this area seeks improvements in materials and methods for replacing facial parts lost to disease or surgical treatment.

Scientists at the Dental Institute are responsible for developing new techniques and new materials to restore facial features lost through cancer or accident.

CLEFT LIP AND PALATE rob many children of a normal life . . .

Cinefluorography is used to study the motions of chewing, swallowing, and speaking. X-ray motion picture film is projected in slow motion against the ground glass, and each tiny movement can be sketched, analyzed, and studied to determine variations in health and disease.

Facial anomalies constitute a research problem of the first order. A child born with a cleft lip or palate has difficulty with breathing and eating from the moment of his birth. In childhood, he speaks badly, hears imperfectly, and feels embarrassed and afraid. In adulthood, he is silent, withdrawn and uncomfortable, facing many obstacles to his health and happiness. The fundamentals of life—eating, breathing, speaking, communicating, relating to others—so normal for everyone else, are problems for him.

Facial clefts are among the most common of birth defects. In the United States this anomaly occurs about once in 800 births. Incidence among all Caucasian groups is practically the same, but appears to be considerably higher among Oriental peoples and lower among Negroes.

The cleft lip and cleft palate can occur separately or together, unilaterally or bilaterally, and in various positions. Sometimes the cleft occurs submucosaly, and although the cleft is not obvious, it still impairs function.

RESEARCH PROGRESS

Today's attack on cleft lip and palate is being carried on by multidisciplinary teams of researchers in large centers which embody both clinical and basic studies. Causes of clefts are under intensive search by basic scientists—geneticists, embryologists, biochemists, physiologists, and pathologists.

Mechanical, chemical, infectious, and metabolic factors, both before and after conception, are being studied.

Posterior cleft palate in an infant.

Cleft palate babies have much difficulty in taking food because they lack a solid surface between nose and mouth. With associated disabilities of respiration, they may become severely malnourished. Dental Institute pediatricians designed a special, curved bottle feeder (right) for these babies. The infant's position allows normal patterns of motion of the tongue and mandible, and thus more effective suckle feeding.

In other clinical fields, surgeons, speech therapists, orthodontists, pediatricians, psychologists, and others are developing improved criteria for surgical evaluation, clinical treatment, speech rehabilitation, and hearing improvement.

Longitudinal growth studies, begun more than a decade ago, are yielding valuable information in assessing various therapeutic procedures. Progressive recording of facial growth for each child under observation begins as early as 1 week after birth. Cephalometry, cinefluorography, and plaster molds of face and palate provide records of growth, development, and functional change. As a result of these studies, trends in operative intervention have already changed. Reconstruction geared to optimal physical and psychological maturation has created new attitudes on the part of

Geneticists have found a number of conditions in which individuals have extra chromosomes. Some forms of cleft lip and palate are associated with chromosomal defects. Above, a Dental Institute geneticist is shown at a phase microscope used in chromosome studies.

surgical teams. The participation of the orthodontist and prosthodontist has become a key factor.

Knowledge of compensatory activities of nerve and muscle-controlling soft tissue movements in oral-facial handicapped persons offers an understanding of the capabilities of the handicapped individual and an approach to therapy.

Studies of oral-pharyngeal adaptive mechanisms in the human depend largely on X-ray sound motion pictures through which movements of tongue, jaws, and throat can be evaluated in speech and swallowing, and at rest. Assessment of the patient's problem by examination of response to stimuli in the pharyngeal area has also progressed.

However, since pharyngeal activities are coordinated through complex reflex pathways, physiologic studies or oral dynamics are not simple. Disturbances of sensory input, changes in muscular capability, and impairment of oral performance must all be considered in efforts to establish criteria for sensory-motor loss and the potential for repair.

The accomplishments in the light of the size of the problem are thus far only steps:

A special type of feeder has been developed to permit better nutrition of the infant with a cleft palate before surgery can be undertaken.

Studies of development indicate that orthodontic therapy to position maxillary segments before surgical closure offers more normal developmental possibilities.

Model systems have been developed in animals to produce experimental clefts by changes in intrauterine pressure, drug administration, and other means.

Techniques of speech therapy, cinefluorography, electromyography, and cephalometry have regularly improved.

Training programs for interdisciplinary teams of scientists are today a reality.

It remains for research of the future to provide the rest of the story—why clefts occur, how they can be prevented, how treatment can be perfected.

DENTAL RESEARCH

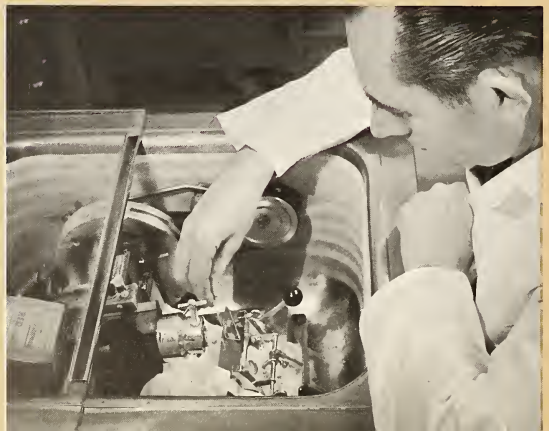
explores the fundamentals
of biologic processes

STUDYING THE BUILDING BLOCKS OF THE BODY THROUGH BIOCHEMISTRY

The biomedical scientist may long ago have been able to relate his studies solely to the clinical manifestations of his specialty. Today, however, he has the additional obligation of delving ever more deeply into fundamental factors in the development and structure of the body and its tissues.

The chemical building blocks of nature and the metabolic processes through which these substances develop and change in the body are a major area of study at the Dental Institute. Here, biochemists pursue intricate studies of the physiological and metabolic

Frozen sections of fresh decalcified bone are cut with the cryostat (an apparatus which maintains temperature at extremely low levels) for histochemical and enzymatic determinations.



Dental research reaches to the building blocks of living cells—the amino acids—to seek answers to the enzyme's ability to transform these and other compounds.

Photomicrographs show enzyme tissue changes resulting from scurvy in guinea pigs. Jars hold bones and teeth of scorbutic animals.

effects of fluoride on the skeletal and dental tissues, explore the chemical effects of nutritional changes, analyze protein and enzyme structure, and separate and analyze specific components of the ribonucleic acid molecule.

The study of protein synthesis and collagen structure has been particularly important, since collagen is the principal constituent of bone, connective tissue, and dentin, comprising one-third of total body protein. Biochemical research at the molecular level seeks to decipher the changes in collagen and its kindred substance, elastin, in aging and disease.

Protein chemists have identified not only the coiled polypeptide chains of the collagen molecule but also the nature of the cross-linking between these chains within the molecules and between the molecules in the collagen fiber. Through experimental changes in the collagen molecule, they have shown that damage to cross-links results in damage to the connective tissue.

ANALYZING INTRACELLULAR MECHANISMS

While the biochemist has worked out a structural image for the collagen fiber, the histochemist in dental research has developed techniques for demonstrating the presence or absence of enzyme activity in these tissues at a cellular level. By preserving enzyme activity even after a specimen has been demineralized, these techniques permit a better elucidation of the enzyme pattern in the cells of developing bones and teeth and the differences in enzyme activity in various types of cells during disease stages.

PROBING ULTRASTRUCTURE

Only since the advent of the electron microscope has it been possible to gather information about the structure and composition of teeth, because details of the very fine structural elements of both enamel and dentin are too small to be seen through the light microscope.

The electron microscope and thin sectioning techniques developed during the last 30 years now permit visualization of these minute structures, as well as other hard tissues of the body. As a result of these studies, the processes by which mineral crystals form in developing enamel and the processes of degradation of enamel in caries can now be described with considerable precision. These techniques have also contributed to a better understanding of areas of differing mineralization, the effects of fluoride on bone crystal, and the relationship of organic and inorganic components in the hard tissues of the body.

X–ray diffraction methods provide the biophysical investigator with another effective tool for study of the chemical composition of mineral and protein components and actual atomic arrangements within crystals.

Preparation of specimens for examination under the electron microscope is complicated and exacting. Shown here are a few of the more than 100 steps between cutting out of living material and its inspection under the microscope. Tissue sections about 250 times thinner than those ordinarily made for light microscopy must be cut on a microtome, an instrument specially designed to advance the specimen a millionth of an inch between each cut.

Scientist examines picture of mineral crystals from tooth enamel, photographed under the electron microscope (magnified 300,000 times).

In an initial step toward preparing a specimen for cutting, tissue is embedded in epoxy resin and reduced to a cube less than ½ mm. on each side with a razor blade.

Both diamond and glass microtome knives are used in cutting specimens. Glass knives are made in the Dental Institute's laboratories. The two squares of plate glass shown being prepared will be broken diagonally in the next step to produce the final knives.

Thin sections are produced on the microtome as the tissue cube moves across the cutting edge of glass knife. As they are cut, the sections float onto a water surface.

Specimen is picked up from water bath in a wire loop and placed onto a small copper grid—counterpart of the glass slide used in light microscopy. Mounted sections can now be viewed under the electron microscope. Generally, they are subjected to further preparatory steps, such as staining.

Germ-free animals are housed in steel and plastic tanks in the Dental Institute's laboratory building at the National Institutes of Health. This valuable research tool permits evaluation of diet, host resistance, and inheritance factors. Generations of rats have grown up in these tanks, untouched by bacteria. As long as they stay in this protected environment, the animals remain completely free of tooth decay. With the introduction of single specific forms of bacteria, study of caries and periodontal disease patterns is possible.

Technician inserts hands in rubber gauntlets attached to tank, permitting him to work with animals without contaminating their environment with bacteria.

Transferring a germ-free rat from a Renier tank to a plastic tank under completely sterile conditions. Transfer jar is first sterilized in clave attached to Renier tank.

Scientist inoculates rat inside germ-free tank. Inoculation with specific strain of cariogenic streptococcus (decay-producing bacteria) causes cavities to develop.

Rat's-eye view inside tank.

EXTRAMURAL PROGRAMS

extend research on oral diseases
and train future scientists

RESEARCH SUPPORTED in over 100 institutions

Almost four-fifths of the annual budget for the Dental Institute is used to support research in other institutions throughout the United States and in several foreign countries.

Applications for grants to carry on research come in from investigators in universities, medical centers, hospitals, dental clinics, and other types of research institutions in the United States and other countries. All are carefully examined and evaluated by teams of independent nonfederal scientists who study the research plans, the goals and objectives, the qualifications of the investigators, the proposed budgets, and the facilities available for the proposed research.

Grant-supported research is conducted by each of the 50 schools of dentistry in the United States. The clinical faculty members of the dental schools hold research grants for studies of periodontal disease, caries, cleft palate, temporomandibular joint problems, tooth implantation, anesthesiology, and a multitude of clinical

Professor of chemistry at the University of Maryland checking sound absorption equipment which was developed at the university.

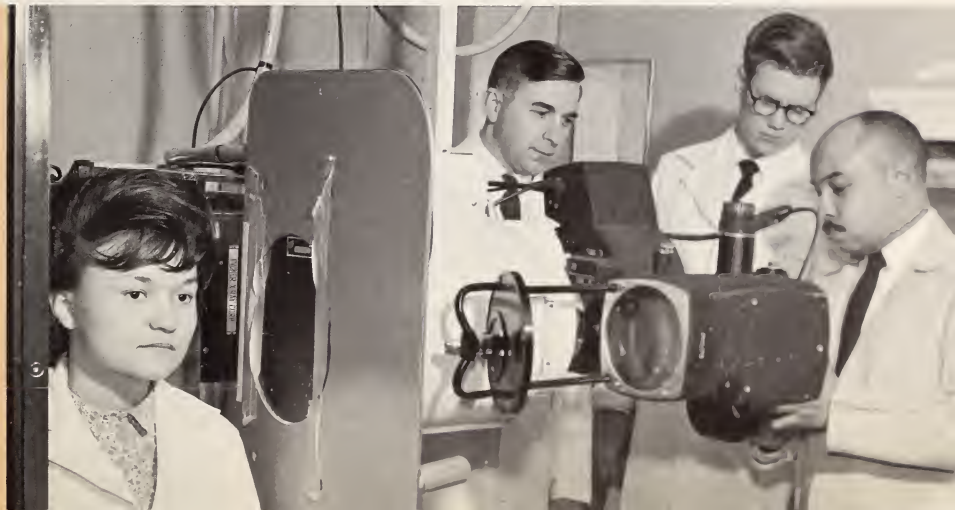
problems. Faculty members in the basic science departments hold research grants in biochemistry, microbiology, pathology, pharmacology, anatomy, and far-reaching basic areas. In dozens of dental clinics, universities, and research hospitals, studies range from the virus diseases to the development of newer materials for restorative processes.

Beyond the dental environment, the needs of dental research have attracted some 100 other departments or institutions to participate in the extramural programs. These activities involve persons from widely dispersed areas of academic life.

Engineers are studying stress factors related to dental materials and appliances. Anthropologists are searching out ancient skulls to establish disease pathways of antiquity and to consider their meaning for modern man. Epidemiologists study factors of climate, geography, and nutrition as they relate to dental disease around the world. Behavioral scientists investigate the patterns of family and individual living which affect disease processes. Ceramists and metallurgists work with the materials dentists use today and will use in the future. Specialists in surgery, speech pathology and psychology study the needs, the methods, and the appropriate treatment plans for patients afflicted with all types of serious facial disabilities and painful deformities.

Grant-supported dental research all over the world shows a trend toward areas of basic and fundamental study, which can benefit man's knowledge on many categorical disease entities. The use of interdisciplinary teams of biophysicists, chemists, biologists, and other scientists has given research plans wide scope.

From the interplay of the Dental Institute and the world of dental education comes new knowledge for the future, new research concepts, new combinations of disciplines, new applications of old ideas, and clues to the prevention and treatment of disease.



Members of the Department of Dentistry and Dental Research, University of Rochester (New York) inspect cinefluorographic equipment used in conjunction with a mandibulographic device for synchronous recording of movements in the temporomandibular joint and the mandible.

Baby caimans (South American alligators) are studied in a grant-supported research project at the University of Pennsylvania. Caimans, unlike humans, continually produce new teeth throughout their lives, offering the investigator an unusual research opportunity.

Stained cleft palate slides are selected for study in research at the University of Pittsburgh.

Research of tomorrow needs more scientists

Since modern dental research encompasses many disciplines and basic sciences, the Dental Institute must support training for research in wide-ranging fields. Scientists trained in computer techniques, crystallography, metallurgy, physical anthropology, behavioral science, statistics, biochemistry, biophysics, histology, physiology, microbiology, and other basic sciences are as much needed as pedodontists, prosthodontists, orthodontists, and oral surgeons.

The Congress annually appropriates to the Dental Institute funds to make grants to universities and to other training institutions and to provide support for individual students and scientists.

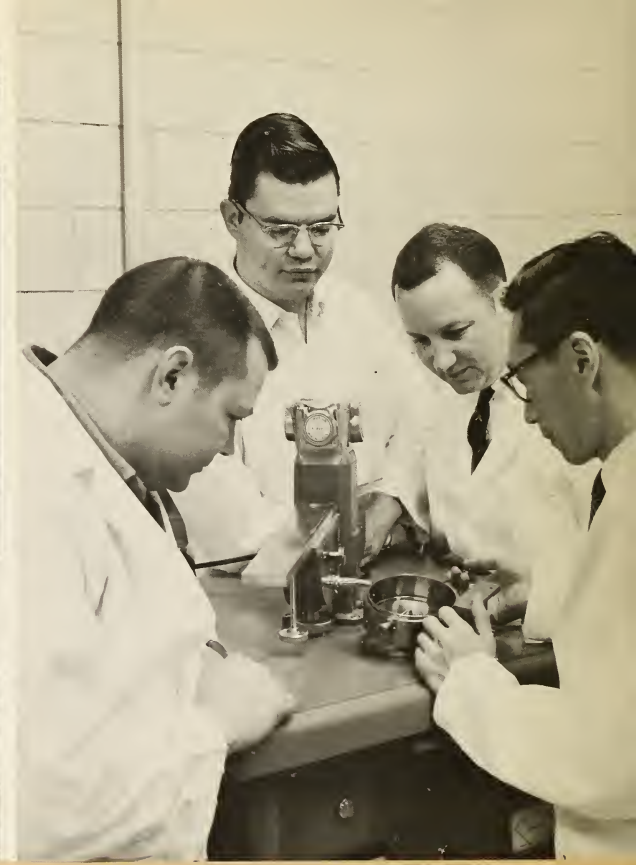
Through stipends disbursed from graduate training grants to universities, students can develop skills in clinical and basic research related to dentistry. Some train for the Ph. D. degree, some for combined Ph. D. and D.D.S. degrees.

Through fellowship awards, qualified individuals can be supported in a field basic to dental research. Research Career Development Awards provide support for junior scientists.

It has been estimated that manpower in dental research should be tripled by 1970 if adequate progress is to be made to meet the oral and dental health needs of the United States.

The Institute, through all the paths open to it, is seeking to define ways to increase the number of scientists engaged in dental research by creating a favorable research environment in dental schools and appealing to scientists of all disciplines.

NIDR Trainee at the University of Washington prepares to cannulate the parotid ducts of the rat as part of his thesis work to characterize the proteins in rat parotid saliva.



NIDR trainees in calcification studies at Duke University, Department of Zoology, shown receiving instruction in X-ray diffraction equipment.

U.S. GOVERNMENT PRINTING OFFICE : 1965 O—776-442

PARKLAWN HEALTH LIBRARY
3 2031 00035573 2

Prepared by
Staff of the Information Office
National Institute of Dental Research

PHOTO CREDITS

All photographs, except those credited below, were taken by the Photography Section, Division of Research Services, National Institutes of Health.

University of Maryland
University of Rochester
University of Pennsylvania
University of Pittsburgh
University of Washington
Duke University

Public Health Service Publication No. 1340